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Magnesium in Health and Life

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Magnesium in Health and Life

When this earth was formed for a habitation everything needful for the proper nutrition of all living things—vegetable and animal—was placed in the earth.

—Dr. G. W. Heard

Major and Trace Mineral Associates

The soil contains some one hundred isolated minerals. Many of them, as of this date, have been found to be essential, in various amounts, to health and life in plants, animals, and man. Scientists tell us that phosphorus, calcium, potassium, magnesium, chlorine, sulphur, and iron are the most important macronutrients of life and that copper, zinc, manganese, iodine, and possibly cobalt are some of the better-known micronutrients, required only in trace amounts.

According to a recent report, Dr. Schrauzer, a Professor of Chemistry at the University of California, reported that molybdenum is also a trace mineral nutrient that may have nutritional function. His experiments indicated that this mineral acts as a catalyst and enables the body to change nitrogen (protein) into ammonia. He believes this process to be very essential in cellular function. Further evidence of mineral essentiality is, no doubt, to be expected. In the meantime, it is apparent that we must find quality, all-inclusive, organic mineral-containing food. In addition to the above-mentioned minerals, some plants seem to need boron, silicon, strontium, and vanadium. Some aluminum has been found in plants and animals, but, as of now, it has no demonstrable value.

The function of plants is to take up the inorganic minerals present in the soil and change them to organic minerals that animals and humans can properly utilize. Near Hereford, Deaf Smith County, Texas, where Dr. Heard practiced dentistry for over twenty years, the wheat plant roots often penetrated over eight feet to reach the strata-rich calcium and magnesium below.

From the U.S. Dept. of Agriculture, Miscellaneous Publication No. 369, we learn that plant pathologists have proven these elements to be interrelated and that the effectiveness of one is determined by the proportionate presence of the other. The necessity for a balanced source of nutrients for the plant is indicated, due to the fact that when one of the principal nutrients is deficient in the soil solution, the others are taken up by the plant in amounts greater than normal, while even less of the deficient nutrient is absorbed than would be expected normally.

Mineral composition of crops changes according to age or stage of maturity. Therefore, the exact time of harvest must be a consideration in obtaining the desired nutritional quality. In nature calcium is always accompanied by magnesium, and they represent the opposite pole of potassium. Experiments prove that calcium and magnesium in the soil make potassium more available and increase plant carbohydrate content. However, too much potassium affects the uptake of magnesium. It is for this reason that nitrogen-phosphorus-potash (commercial fertilizer) is so often unbalancing and should be reinforced with the necessary lacking essential minerals, including magnesium, to produce better nutrition, instead of attempting to stimulate yield only.

In 1957, soil crop scientist F.E. Bear et al. found that "food plants from high-yield areas, forced by chemical fertilizers, contain more carbohydrates and are lower in protein and minerals than less luxuriant growth."

It has also been proven that magnesium salts can only exert their nourishing function to the plants in the presence of calcium salts, so absence of calcium may also have an injurious effect. Back in 1923, food scientist Otto Carque was quoted as follows, "Organic salts…the most essential factors in the body in maintaining vitality and increasing its power of resistance. Indeed, the wonderful creative work of nature throughout the plant and animal world is largely due to the actions and reactions of the mineral elements and their vibratory forces."

Magnesium Indispensable

Magnesium is indispensable to all living things, whether vegetable, animal, or human. Blakiston defines magnesium as "abundantly distributed throughout inorganic and organic nature and essential to life."

Magnesium is the fourth macro-mineral in order of cation abundance and closely related to calcium, phosphorus, and potassium in tissues and fluids of the body. With calcium and phosphorus, it becomes a part of the hard bone substance, and combined with potassium it is a partner in the soft tissue structure. Primarily, magnesium is involved in such reactions as nerve conduction, methyl group transfer, muscular activity, glucose utilization, oxidative phosphorylation, as well as the synthesis of protein, carbohydrates, fats, and nucleic acid. Then too, it is apparently involved in some chronic debilitating illnesses in which the overworked adrenal glands have failed in the regulation of potassium and sodium balance.

Although present in most cells in a very minute quantity, magnesium plays a large part in metabolism. From its location in the cell it functions as a catalyst and the regulator of many enzymatic reactions. It also has an important role as a coenzyme in the building of protein.

Transport Maintenance

Maintenance of the mechanism necessary to continue the magnesium gradient across the cell membrane is not as yet understood. However, it appears very likely that the entry of magnesium into the cell must be an active process. Due to this intracellular function of transport across membranes we find that unlike the specific concentration of calcium and phosphorus, magnesium is quite evenly distributed in the various organs and tissues of the body. It is in this respect that the kidneys, large and small intestines, and the omentum seem to be the main avenues of transport.

Balance Control

As with other major minerals the balance of magnesium in the body is mostly controlled by kidney function. The glomeruli filter it from the blood, and it is then normally reabsorbed by the kidney tubules at about the saturation level. It is presently felt that the renal mechanisms that regulate magnesium excretion are apparently separate from those of the other mineral ions, with the possible exception of calcium, where kidney disease is present.

In Body Structure

Of the twenty grams of magnesium found in the body, approximately 70 percent is found in the skeletal structure associated with calcium and phosphorus. The proportionate ratio of calcium phosphate and magnesium phosphate in bones is about 50:1. Yet it has been reported that this small proportion of magnesium strengthens the bones and teeth and prevents osteomalacia curvature of the spine and decay of teeth.

In regard to the latter, Hereford, Texas, is often called "The Town Without a Toothache." Dr. George W. Heard, a local dentist for many years, was convinced that tooth resistance to decay in that area was due to the high concentrate of magnesium salts together with calcium and other minerals in the food grown there. Some other people had a theory it was due to fluoride salts in the water. In his book *Man Versus Toothache*, he stated emphatically:

> "I disagree completely with the theory that the fluorine in the water is mainly what prevents tooth decay…It appears that people have not discovered the difference between organic and inorganic minerals and vitamins. They do not differentiate the two kinds of fluorine—one is food, the other is poison. The water in Hereford contains about 2 ppm, while wheat contains many hundred ppm. In wheat it is food, in water it is poison. I have concluded from these observations that any immunity to tooth decay which fluorine may provide is best had through organic fluorine, which, as spectrograph analysis shows, both our wheat and our milk contain…We need not only to prevent caries, we need to immunize every organ."

In 1933, Otto Carque again reported on his experiments in *Vital Facts About Food*, wherein he verified Dr. Heard's observations on magnesium when he stated:

> "Bones average about 1 percent phosphate of magnesium and teeth about 1½ percent phosphate of magnesium. Elephant tusks contain 2 percent of phosphate of magnesium and billiard balls made from these are almost indestructible. The teeth of carnivorous animals contain nearly 5 percent phosphate of magnesium, and thus they are able to crush and grind the bones of their prey without difficulty."

From this we must conclude that magnesium is the real tooth toughener.

In 1950, Lewis B. Barnett, MD, a local Hereford physician and orthopedic surgeon, became interested in the research of Carque, Delbet, and Heard and decided to investigate the mystery of osteoporosis in old age. At the time, this condition was generally considered inevitable for men and women over fifty years of age, as a normal part of aging. Apparently, the bones, especially the femur, were deteriorating (losing density and becoming porous) faster than the bone cells could be rebuilt. Brittleness took the place of flexibility, and the greenstick fracture of the young became the complete fracture of the aged, usually at the neck of the femur.

In his preliminary research, he found that in Dallas, as in most other areas of this country, osteoporosis and slow bone healing was prevalent. If fractures healed at all, after occurring at the average age of sixty-three, it required approximately six months. In comparison, if fractures did occur in Hereford, it was at an average age of eighty-two and the healing time was about two months. This was a remarkable difference and a great incentive for Dr. Barnett to continue his research.

In the water analysis comparison between Dallas and Hereford, Dr. Barnett decided that the slight difference in the content of fluorine, iodine, and phosphorus was statistically insignificant. Dallas water contained almost six times more calcium, so that also was eliminated as irrelevant in explaining the inferiority of the Dallas water. However, Hereford water contained *twice as much magnesium as Dallas water*, so this was considered proof of its importance.

In a study of some 500 women in their early fifties, Dr. Barnett confirmed the importance of magnesium in bone health. Apparently, magnesium is the adhesive binder which holds calcium, fluorine, phosphorus, silicon, and the other bone contents together. Without it, the other bone elements seem to be washed away and porosity takes over. In a later study of some five thousand people, approximately 60 percent of them were found deficient in magnesium. As Dr. Barnett stated, "One of the most important aspects of the disease, osteoporosis, has been almost totally overlooked. That aspect is the role played by magnesium…Our studies have convinced us that the mineral is important—perhaps the most important single element in bone health…Since they seem to desire to add things to the water supply, perhaps they should have considered magnesium."

In Soft Tissues

The remaining 30 percent of the body's total 20-gram supply, outside of the skeletal framework, is mostly in the blood and soft tissues as an intracellular entity like potassium. But, in comparison, the concentration is almost infinitesimal. This small amount involved in so many functions in the body attests to its having been labeled as a "dynamic action mineral." Even though the amount is small, soft tissues and muscles contain three times as much magnesium as calcium. In the muscles it serves as a relaxer.

Ionic Partners

Combined with calcium and other minerals, magnesium is also found, in small quantities, in various combinations in the extracellular body fluids. Certain of these macrominerals, namely calcium, phosphorus, sodium, potassium, and magnesium, predominate in various parts of the organism. When they are in balance the body is said to be in "ionic equilibrium." Calcium with magnesium, sodium, and potassium regulates neuromuscular excitability. It is well known that calcium depresses excitability, but its effects depend upon the concentration of other ions as well. The irritability of the nerves is increased when the amount of calcium in the blood is below normal. As an ionic partner with calcium, magnesium is especially linked to and often confused with calcium effects in neuromuscular excitability.

It is also well known that magnesium plays an important role in our neurological responses. But, as to whether the magnesium syndrome is likely to be a simple or complex state of ionic imbalance, involving potassium, calcium, and other ions is a subject of frequent debate. As long as "ionic equilibrium" is the criterion to be sought in the regulation of neuromuscular excitability, perhaps we should forget the debate and provide generous amounts of all these mineral ions from natural sources, at least at the time of stress, to lessen the amount that must otherwise be reclaimed from the body tissue reserves.

In Excess

As early as 1908, Meltzer and Auer reported that an excess of magnesium produced narcosis. In the *Medical Letter* of November 17, 1967, it is noted that "magnesium in humans may occur in excess or as a deficiency and that clinical effects are often misinterpreted and very likely attributed to other causes."

Scientists now agree that excesses have become more infrequent and that a deficiency is more likely to occur. A few abnormal instances of excess have been noted when some patients, for example, have abused the use of laxatives, such as Milk of Magnesia (magnesium hydroxide), which can also aggravate alkalinity.

Magnesium Deficiency

From Dr. E.V. McCollum, an early nutritional scientist and author of *The Newer Knowledge of Nutrition*, we learn as follows:

> "My associates and I have given considerable attention, during recent years, to the study of the effects of magnesium deficiency in the rat and the dog. We were able to reduce the content of magnesium in an otherwise adequate diet to 1.8 parts per million. On this diet, too, young rats respond within 12 to 15 days with a reduction of the magnesium content of the blood from the normal of about 2.5 mg per 100 cc to less than half this value. This diminished magnesium in the blood brings about a striking chain of symptoms—vasodilation, acceleration of the heartbeat, and convulsions, ending in death. The only change in the composition of the blood, other than magnesium, which we have been able to detect, is marked increase in the cholesterol ester level. The blood calcium remains normal. The animals are hyperirritable, and respond to much smaller stimuli (electrical) than do normal ones…A few clinical investigators have reported low values for magnesium in human subjects suffering from hyperirritability."

Kruse et al. verified this in 1932, when they found that muscular spasms and hyperirritability resulted from lack of sufficient magnesium. Previously, some physiological scientists had noted physiological and pathological changes present with magnesium deficiency, but hard to detect with the methods at hand. As indicated previously with potassium, the serum magnesium level may not always reflect the cellular magnesium level. And, as also with potassium deficiency, a loss of magnesium from the body cells occurs as a result of severe diarrhea or vomiting. Either, or both, contribute to exhaustion and probable acceleration of age. As McCollum determined with animals, apparently the need for magnesium in humans is also increased if cholesterol is high. Its presence in the diet in some instances has obviously helped to prevent atherosclerosis.

Magnesium and Age

In 1930 Dr. Pierre Delbet of the Academy of Medicine in Paris, France, as a result of animal experiments, reported that in aging the amount of magnesium in the body decreases, and the amount of calcium increases. In some experiments, calcium was found to be three times more abundant in aged rabbits. He also found that the muscular system was short lived and that the nervous system lasted much longer.

Another first was his experiments with magnesium in tumors of glandular origin, in animals. Delbet concluded that "the role of magnesium in organic synthesis leads one to think that it must diminish with age…Added calcium and diminished magnesium are characteristics of the senile testicle. In the brain and in the testicle, the relationship with age is of the same degree, but it appears certain to us that at the time that life is waning, magnesium diminishes, while calcium rises. Now, everything that is known about the chemical magnesium, about its action in the synthesis of chlorophyll, justifies one in thinking that its reduction plays a role in senility, or at least in certain phenomena of senility."

Endocrine Involvement

Apparently, science now seems to concede that the pituitary gland needs and uses magnesium in the regulation of the other endocrine glands. Other scientists have now verified the findings of Greenberg and Mackey (1932) that the parathyroid glands show a rise in the plasma magnesium concentrate in dogs injected with parathyroid extract.

In 1955, Mader and Iser found that in man, the adrenal glands are involved in hyperaldosteronism (associated with negative magnesium balance) and hypomagnesemia (a state of magnesium deficiency in the blood manifested by twitching and convulsions). As previously mentioned, the relationship between magnesium and the hormone cortisone affects the amount of phosphate in the blood. A recent report concluded that osteoporosis can be caused by overproduction of adrenal steroids, or large doses of corticosteroids. However, in 1963 Carey and McDonald found magnesium homeostasis secondary to their important influence on potassium and sodium homeostasis.

In 1957 Vitale et al. found the thyroid gland involved, in that the depression of growth rate in growing rats (resulting from thyroxine feeding), could be partly overcome by supplementing the diet with large amounts of magnesium.

Enzymes Need Magnesium

Magnesium activates an entire series of enzymes useful in phosphate transfer. In his book *Nutritional Factors and Enzymological Distribution in Animals*, Dr. C. H. Gallagher, a veterinary scientist from London, lists thirty-seven enzymes involved in the transfer of phosphates. He also lists twenty-one where magnesium cooperates with other enzymes, and twenty-six where the enzymes are activated by magnesium in conjunction with other divalent cations. Therefore, to date, we find magnesium involved in activating at least one series of eighty-four enzymes.

This surely is an indication that any deficiency of magnesium must be incompatible with life. The metabolism of normal body function is a situation of delicate balance, particularly enzymatic, harmonic, and osmotic balance. The many varied involvements of magnesium in the body, and its classification by scientists as one of the least understood minerals, creates a situation wherein the further pursuit of research becomes not only a matter of health and life, but also of illness and death.

Magnesium Deficiency Increasing

Since the report of McCollum et al. in 1922 of magnesium deficiency causing hyperirritability, clinicians have found other possibly associated conditions as follows: alcoholism, asthma, central nervous system disorders, congestive heart failure due to degeneration of the modified cardiac muscle fibers of the conduction system of the heart (Purkinje fibers), chronic exhaustion, diabetic states, depressed metabolic states, disorientation, dental caries, depressed growth, epileptic seizures, fast pulse, high blood pressure, insomnia, hallucinations, inflamed pancreas, intestinal obstruction, kidney calcification, kidney stones, mental confusion, neuromuscular disorders, osteoporosis, poor reflexes, prolonged severe diarrhea, postoperative conditions, enlarged prostate, senility, tetany, tumorigenic growths, toxemia of pregnancy, and tremors.

Indications of this widespread deficiency in man is becoming more apparent daily and seems to be responsible for a significant proportion of human illness. From W.A. Krehl, MD, University of Iowa nutritionist, we learn, "An examination of the clinical literature in the past ten years reveals that dietary magnesium deficiency is far more prevalent than we suspected. In our opinion it can be said to have become one of the common nutritional deficiencies in clinical medicine." He went on to say that this was partly due to the fact that scientists failed to realize that magnesium stored in bones is not released when a deficit develops, as is the case with calcium.

Diagnostic Confusion

It has been apparent for some time that magnesium deficiency symptoms can be almost indistinguishable from calcium deficit. From the U.S. Government publication *Magnesium in Human Nutrition*, 1960, page 4, we learn that Barnes, Cope and Gordon reported, "Calcium can ameliorate temporarily at least, symptoms of anxiety, apprehension, tingling, tremor, muscle cramps, weakness, and other neuromuscular disorders, so that calcium and magnesium deficiency states may be confused clinically."

Here it is important to recall that the metabolism of calcium and magnesium must be normal to insure a properly functioning nervous system. As Dr. Krehl stated in *Nutrition Today* (September 1967), "There is no clinical counterpart for calcium deficiency, compared with the disastrous clinical effects of magnesium deprivation. Much more emphasis should be given to the fact that magnesium deficiency may occur under a wide variety of not uncommon circumstances; far more so than is the case with calcium."

Food Must Be Our Source

To prevent a deficit, common sense demands that we must choose foods with a higher magnesium content.

Some Food Sources of Magnesium

Vegetables	Grains	Nuts & Fruits	Fish & Meats	Miscellaneous
Spinach Peas (green) Peas (dried) Beans (lima) Carrots Tomatoes	Wheat Rye Bran Rice (brown) Rice (milk) Buckwheat Soybeans Wheatgerm	All nuts (almonds best) Strawberries All dried fruits	Cod Halibut Beef (lean) Chicken	Bone Eggs Honey Coffee Tea Cheese Brewer's yeast Curry powder Parsley (dried) Dried mustard Cod liver oil Molasses (blackstrap)

Science now recognizes that the newer concept of nutrition must take into consideration the physical integrity of live food and reflect on the value of the electrolytes and "ionic equilibrium," in lieu of its chemical composition only. The intricate structure of food may be altered by improper fertilization of the soil, the addition of various chemicals in processing to ensure shelf life, or by overcooking, since the loss of any mineral, vitamin, or protein may inhibit the formation of enzymes and interfere with proper metabolism.

Again, quoting Dr. Heard, who cheated death for years through better nutrition, "Our body must have food containing every element found in the earth…If we can supply the complete nutritional requirements, the forces of nature will accomplish the rest."

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CONTACT US

+1 (866) 407-9323
+1 (970) 461-4602
5740 Boeing Drive, Loveland, CO, 80538
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Selene River Press is a publishing company specializing in holistic nutrition education. Our philosophy is rooted in the work of Dr. Royal Lee, who showed that vitamin deficiencies, due to processed foods, are responsible for most degenerative disease. From organic farming to food-based vitamins, from raw milk to fermented foods, Dr. Lee set the course for the field of whole food nutrition.

CONTACT US

Toll Free: +1 (866) 407-9323
Local: +1 (970) 461-4602
PO Box 270091, Fort Collins, CO, 80527
info@seleneriverpress.com
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